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ABSTRACT

As the use of National Science Foundation (NSF)-sponsored, reform- oriented mathematics curricula has become more prevalent across the U.S., an increasing number of researchers are attempting to study the "impact" of reform. In particular, mathematics educators are interested in determining whether reforms are having the desired effects on students, particularly with respect to the learning of mathematical content and the improvement of attitudes about mathematics. In this effort, researchers have used a variety of methods, and have looked at a variety of variables, in order to assess the impact of reform. In many cases, such research assesses reform by looking closely at students' scores on tests or their strategies for solving certain kinds of problems. For example, Riordan & Noyce (2001) assessed reform's impact by comparing students' scores on standardized achievement tests. Other researchers have used structured interviews, classroom observations, and more interpretive or ethnographic methods to assess the impact of reform (e.g., Boaler, 1997). Both of these methodologies are useful in assessing the impact that reform mathematics curricula are having on students. An alternative evaluation of the impact of reform that has not been as widely used is through the use of survey instruments. Surveys have been widely and reliably used to assess students' motivation (Pintrich, Smith, Garcia, & McKeachie, 1993), beliefs and attitudes (Kenney & Silver, 1997), and interest (Kšller, Baumert, & Schnabel, 2001). We propose to add to this literature by using a survey to study the impact of reform on students' conceptions of mathematics. (Author)

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ASSESSING STUDENTS' CONCEPTIONS OF REFORM MATHEMATICS

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Introduction and Perspective

As the use of NSF-sponsored, reform-oriented mathematics curricula has become more prevalent across the US, an increasing number of researchers are attempting to study the "impact" of reform. In particular, mathematics educators are interested in determining whether reforms are having the desired effects on students, particularly with respect to the learning of mathematical content and the improvement of attitudes about mathematics. In this effort, researchers have used a variety of methods, and have looked at a variety of variables, in order to assess the impact of reform. In many cases, such research assesses reform by looking closely at students' scores on tests or their strategies for solving certain kinds of problems. For example, Riordan & Noyce (2001) assessed reform's impact by comparing students' scores on standardized achievement tests. Other researchers have used structured interviews, classroom observations, and more interpretive or ethnographic methods to assess the impact of reform (e.g., Boaler, 1997). Both of these methodologies are useful in assessing the impact that reform mathematics curricula are having on students. An alternative evaluation of the impact of reform that has not been as widely used is through the use of survey instruments. Surveys have been widely and reliably used to assess students' motivation (Pintrich, Smith, Garcia, & McKeachie, 1993), beliefs and attitudes (Kenney & Silver, 1997), and interest (Köller, Baumert, & Schnabel, 2001). We propose to add to this literature by using a survey to study the impact of reform on students' conceptions of mathematics.

Background

Few survey measures have been developed for the purpose of studying secondary students' conceptions of mathematics. One such measure is the Conceptions of Mathematics Inventory [CMI] (Grouws, 1994). The CMI is intended to assess students' beliefs or conceptions about mathematics. Its 56 questions asked students whether they agreed or disagreed with certain statements about what it means to do, learn, and think about mathematics. The survey questions fall into seven categories (the composition of mathematical knowledge, the structure of mathematical knowledge, the status of mathematical knowledge, doing mathematics, validating ideas in mathematics, learning mathematics, and the usefulness of mathematics), each of which assesses a different aspect of students' beliefs toward math. Students' responses for each question were

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between 1 and 6, with "1" expressing strong agreement and "6" expressing strong disagreement. A student who mostly agrees with all questions would seem to have an attitude that the survey designers felt was consistent with the aims of recent reform documents. Such a student would view mathematics as being composed of a useful, coherent, and dynamic system of concepts and ideas, where learning is accomplished by sense-making and authority is found through logical thought. A student who mostly disagrees with statements on the CMI would find mathematics an irrelevant, unchanging collection of isolated facts and procedures, handed down from a book or teacher, that must be memorized; this is a view that the CMI designers consider more typical of traditional math curricula.

Grouws and colleagues (Grouws, Howald, & Colangelo, 1996) gave the CMI originally to 163 9th, 10th, and 11th graders in traditional mathematics classes. Their intent was to determine whether students in advanced mathematics classes had different conceptions of the discipline than students in "regular" track. Although the questions on the CMI are intended to indicate whether students' conceptions are consistent with the goals of reform, the CMI has never been administered to a large group of students in reform mathematics classes to "validate" its effectiveness. In other words, although it may seem obvious that students with extensive experience in reform mathematics would have more reform-oriented conceptions than those with extensive experience in traditional mathematics, we made an effort to empirically explore whether students in reform and traditional settings would respond differently on a validated survey instrument.

In this paper, we describe our attempt to validate the CMI. In addition to providing evidence of the effectiveness of the instrument, such a validation also allows the CMI to be used as a measure of the impact of reform, in that it establishes "baseline" values for reform and traditional students' conceptions.

Method

In conversations with the authors of the CMI (Grouws, personal communication, October 5, 2001), we became convinced that all of the 163 original respondents to the CMI (Grouws et al., 1996) came from traditional backgrounds in mathematics. In other words, although no data were collected about the schools, courses, or instruction experienced by students in Grouws and colleagues' original sample, we are confident that no student in this sample had any recent experience with NSF-funded reform-oriented curricula, and thus experienced something of a default approach to teaching mathematics that was more traditional than reform-oriented.

For the present study, and as a contrast, we sought to assess a sample of students who had as "pure" of a reform experience in mathematics as we could find. As part of our work in a number of teacher professional development and curriculum writing projects in Michigan, we developed relationships with several schools with exemplary enactments of reform curricula, particularly at the middle school level. Through these

connections, we recruited 134 9th grade students from a high school in Michigan to complete the CMI, early in their 9th grade year. All students completed at least three years of reform-oriented instruction (in 6th, 7th, and 8th grades) in a middle school whose curriculum (Connected Mathematics Project, Lappan, Fey, Fitzgerald, Friel, & Phillips, 1997) and instruction we were quite familiar with and that we are confident was an extremely well-enacted version of reform. Students were administered the CMI in their regular mathematics classes by their teacher.

Results

To summarize our main results, we found that students from a reform background responded differently to the items on the CMI than did students from a traditional background. In particular, students' responses in the reform setting were more aligned with reform-oriented ideas on the scales of the CMI than traditional students' responses. Table 1 shows students' mean scores on the six scales of the CMI, for both groups of students. Recall that all items used a six-point scale, and that the lower the number, the more reform-oriented the response. The differences on each scale are statistically significant, $p < .01$.

Table 1. Participants' mean scores (standard deviations) on CMI scales

	Composition	Structure	Status	Doing	Validity	Learning	Usefulness
"Pure" traditional	3.90 (0.9)	3.69 (0.8)	3.69 (0.9)	3.89 (0.9)	3.96 (0.9)	3.73 (0.8)	3.50 (0.8)
"Pure" reform	3.34 (0.5)	2.76 (0.7)	2.75 (0.7)	2.65 (0.6)	3.01 (0.6)	3.01 (0.5)	2.20 (1.1)

Discussion

Our results provide evidence that the CMI is a useful and valid instrument for assessing the impact of reform. We found that after experiencing several years of exemplary instruction in a reform curricula, students do develop conceptions of mathematics that are aligned with NCTM reform documents.

Assessing the impact of reform is a complex endeavor, requiring the investigation of many aspects of students' experiences and using multiple methods. We believe that assessing students' beliefs about mathematics is vital to this effort.

References

Boaler, J. (1997). *Experiencing school mathematics: Teaching styles, sex, and setting*. Buckingham: Open University Press.

Grouws, D. A. (1994). *Conceptions of mathematics inventory*. Iowa City, IA: University of Iowa.

Grouws, D. A., Howald, C. L., & Colangelo, N. (1996, April). *Student conceptions of mathematics: A comparison of mathematically talented students and typical high school algebra students*. Paper presented at the American Educational Research Association, New York.

Kenney, P. A., & Silver, E. A. (1997). *Results from the sixth mathematics assessment of the National Assessment of Educational Progress*. Reston, VA: National Council of Teachers of Mathematics.

Köller, O., Baumert, J., & Schnabel, K. (2001). Does interest matter? The relationship between academic interest and achievement in mathematics. *Journal for Research in Mathematics Education, 32(*5), 448-470.

Lappan, G., Fey, J. T., Fitzgerald, W. M., Friel, S. N., & Phillips, E. D. (1997). *Connected mathematics project*. Palo Alto, CA: Seymour.

Pintrich, P. R., Smith, D. A., Garcia, T., & McKeachie, W. J. (1993). Reliability and predictive validity of the Motivated Strategies for Learning Questionnaire (MSLQ). *Educational and Psychological Measurement, 53*, 801–813.

Riordan, J., & Noyce, P. (2001). The impact of two Standards-based mathematics curricula on student achievement in Massachusetts. *Journal for Research in Mathematics Education, 32(*4), 368-398.

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